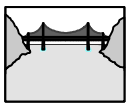
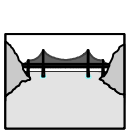


Appendix II-A

What the Assessment Must Include

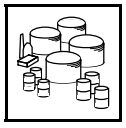


Appendix II-A
What the Assessment Must Include

The Columbia River Comprehensive Impact Assessment (CRCIA) examines the process of exposure and harmful effects of Hanford-derived contaminants in the Columbia River to humans, ecosystems, and cultures. The requirements in this appendix define what factors must be included in assessing river impact in order to understand this process. These factors, compiled for each segment of the exposure process and variant scenarios (Section 1.0 through 10.0), constitute the all-inclusive set of candidates to be considered in the assessment. They are winnowed to a manageable study set as discussed in Appendix II-B.

An acceptable comprehensive assessment must examine Hanford Site materials and contaminants, their containment and eventual release, and their transport and entry into the Columbia River. The assessment must also examine potential receptors, their exposure to Hanford-derived contaminants in the Columbia River, and impact resulting from the estimated levels of exposure. The assessment must either include the specified candidate factors, or, if a factor is not included, the assessment must contain an evaluation that explains why the factor was not included.

The factors required to understand the process of exposure and harmful effects (described in Sections 1.0 to 9.0 of this appendix) are based on current environmental conditions and the disposition baseline for Hanford Site radioactive and hazardous materials (described in Section 11.0 of this appendix). Variations from the current conditions are described in Section 10.0 of this appendix. The extent to which each factor is to be assessed, that is, how well the analysis is to be performed, is defined in Appendix II-B. How the assessment should be conducted is defined in Appendix II-C. How the assessment should be managed is defined in Appendix II-D.



1.0 Hanford Materials and Contaminants (Sources and Inventories)

The requirements in this section call for all contamination sources within the boundaries of the Hanford Site to be considered in a composite source term for assessing impact to the Columbia River. The impact of the entire inventory of radioactive and hazardous materials is required. This includes materials which are not contained, such as those contaminating the vadose zone of the Hanford Site. It also includes materials managed by entities other than the U.S. Department of Energy (DOE), such as US Ecology Incorporated and the Siemens Nuclear Fuels. The inventory shall include estimates of future materials whether imported to the Hanford Site or generated on the site. This section requires the analyst to show that the list of potential contaminants used in the assessment is complete. This section also requires the analyst to rank all candidate contaminants in accordance with CRCIA criteria developed to screen contaminants by their potential contribution to harmful effects. The ranking will enable the assessment effort to always focus on the dominant contaminants regardless of the level of resources allocated to CRCIA (see Appendix II-B).

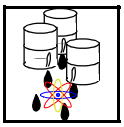
An overview of the requirements in this section is:

(A1.0-1) All existing and potential contaminants and contaminant sources must be identified, characterized, and ranked for significance of potential impact. The characterization shall include atomic or molecular composition, mass, and location. It also shall include reactivity, solubility, and mobility. Materials shall be defined clearly enough to support tracing their movement through the media along their pathway to the Columbia River.

(A1.0-2) A composite source term shall be established that captures all potentially harmful radioactive and hazardous materials and contaminants on or near the Hanford Site.

(A1.0-3) A method to demonstrate and document completeness of the list of inventory sources and compositions used in the assessment shall be developed.

Approximately three and a half additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.



2.0 Containment Failure and Contaminant Release

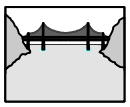
The requirements in this section call for assessment of potential contamination of the Columbia River expected to result from eventual containment failure. Radionuclides and hazardous chemicals are contained during disposal operations by some form of engineered containment. Over time, all containments will eventually allow leaks into the surrounding soil, air or water as containment fails. The analyst must determine when containment failure is projected to occur. The analyst also must determine the rate at which contaminants are projected to be released when containment fails.

An overview of the requirements in this section is:

(A2.0-1) A projected time of containment failure shall be determined based on the method of containment selected in the approved disposal plan. If the disposal plan includes defensible estimates of containment durability, these will be used.

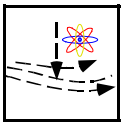
(A2.0-2) The projected rates of release (progression of containment deterioration) shall be determined based on the approved disposal plan.

A2.0-3) Determination of release rates shall consider external migration rates in adjacent soils.



(A2.0-4) Candidate containment failure scenarios that span the range of possibilities shall be established.

An additional page of explicit, detailed requirements for this section has been identified from stakeholder concerns, issues, and experience. It does not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. It should be separately available by this draft's publication date for those who would like to request a copy. It will be included in the final document.



3.0 Transport Mechanisms and Pathways to the Columbia River

The requirements in this section call for transport of Hanford-derived contaminants to the Columbia River to be assessed. Existing transport models will be used to the extent that they satisfy the following requirements. An overview of the requirements in this section is:

(A3.0-1) Contaminant transport through the vadose zone to groundwater shall be assessed.

(A3.0-2) Contaminant transport through the groundwater to the Columbia River shall be assessed.

(A3.0-3) Transport characteristics of geologic formations, such as the Hanford formation and Ringold Formation, shall be established to the degree needed to support the assessment.

(A3.0-4) All other pathways of Hanford-derived contaminants to the Columbia River shall be considered. This shall include but is not limited to atmospheric releases, direct discharges, and transport of contaminants to the Columbia River by contaminated humans, plants, and animals.

(A3.0-5) Migration rates to and concentrations in the Columbia River of all contaminants shall be determined including estimates of holdup periods in travel time calculations.

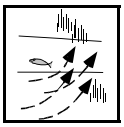
(A3.0-6) Uncertainty in travel times and contaminant concentrations at the point of introduction to the Columbia River shall be assessed.

(A3.0-7) Transport of contaminants through all potentially dominant pathways from the source term to the Columbia River shall be assessed. See Principles and General Requirements and Appendix II-B for definition of "dominant."

(A3.0-8) Chemical forms and physical characteristics of radionuclides, such as solubility and soption rates, shall be considered to the extent that migration rates are affected. This consideration shall include probable modifications of the original contaminants' characteristics as contact is made with soils, groundwater chemistry, and other contaminants.

(A3.0-9) Decay of radionuclides during transport shall be evaluated.

Approximately three additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.



4.0 Contaminant Entry into the Columbia River

The requirements in this section call for the determination of the entry locations and flux of contaminants as they enter the river.

Model and geological/hydrological description requirements must be established for introduction of Hanford-derived contaminants into the Columbia River through groundwater. The rates and locations of contaminant influx to the river must support investigations to determine potential contaminant distribution in the river. (Section 5.0 of this appendix).

Currently, the Hanford Site groundwater discharges into the Columbia River through seeps, springs, river bottom (for example, gravel substrate), and potentially as surface water during storms. Contaminants in dissolved, colloidal, and particulate form, enter the river through these paths.

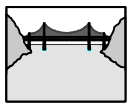
Contaminated groundwater mixes with surface water. The groundwater contamination concentrations are eventually diluted to bulk river concentrations. Mixing begins in porous river bottom and is complete at a currently unspecified distance downstream from each given entry point.

Some of these contaminants can compromise the health of the river ecosystem. For example, early life stages of fish are susceptible to the toxic effects of hexavalent chromium which enters the gravel substrate of the Columbia River bottom. Section 6.0 of this appendix addresses the mapping of habitat critical locations to contaminant concentrations.

Groundwater influx, though difficult to quantify, must be defined. If generalizations are used instead of field data, potentially high concentrations in critical locations may be missed. Groundwater influx locations must be identified, the groundwater at those locations characterized, and the groundwater and expected contaminant loading quantified. The relationship between groundwater influx and river flow (for example, dam operations) must be established. The hydraulic conductivity at a given location greatly affects the amount and concentration of contaminant entering the river at that location.

An overview of the requirements in this section is:

(A4.0-1) Groundwater and surface water interactions shall be evaluated.

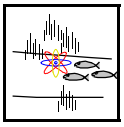


(A4.0-2) The interface with the Columbia River, including seeps, springs, and sub-surface influx into the river, shall be evaluated to support the assessment of biota exposures in the riparian zone and near the river bottom as required in Section 8.0 of this appendix.

(A4.0-3) The groundwater interface with the Columbia River, seeps, springs, and sub-surface influx shall be evaluated to support assessment of contaminant distribution in the river.

(A4.0-4) Valid interfaces shall be defined between groundwater transport assessment and the assessment of groundwater introduction into the Columbia River.

Approximately three additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.



5.0 Fate and Transport of Columbia River-Borne Contaminants

The requirements in this section describe how the assessment must represent the way the contaminant distribution in the river evolves. The Columbia River redistributes contaminants to habitat where the contaminants may injure humans, ecosystems, and eventually cultures. It transports a large amount of water and a much smaller but significant amount of suspended solids (sediment). Some contaminants concentrate on the sediment particles, making them primary dose contributors in some situations.

Suspended sediment is continually settling, especially where flow rates are low. Sediment settles in holes and quiet water regions of the river, such as in sloughs and behind large rocks. Sediment settled on the river bottom can also be resuspended and carried downstream. Dissolved contaminants are carried by the river without settling out. Contaminants that dissolve out of the sediment are carried with the river water.

As slowly flowing groundwater approaches the river channel, it passes through the river bottom into the main body of the river. Contaminant concentration varies as it approaches and passes through the river bottom. Lateral mixing into the main body of the river is slow and not complete for perhaps tens of miles below the point of introduction into the river. Higher contaminant concentrations, resulting from high groundwater concentrations, persist along river streamlines emanating from contaminated groundwater influx points, until the mixing with the less contaminated river water is complete. The concern is redistribution of contaminants to critical locations where they may contact humans, plants, and animals at harmful concentrations and periods of time. Critical locations are defined in Section 6.0 of this appendix.

An overview of the requirements in this section is:

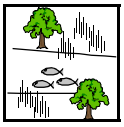
(A5.0-1) The fate assessment of river-borne contaminants (locations of sediment deposits) shall support exposure and dose assessment.

(A5.0-2) The transport assessment of river-borne contaminants shall support exposure and dose assessment.

(A5.0-3) Hot spots (contaminant concentrations) in the Columbia River which result from slow mixing of high concentration contamination sources with river water and suspended solids shall be assessed.

(A5.0-4) All Hanford contamination in the Columbia River environment that has the potential to significantly contribute to habitat or drinking water contamination shall be evaluated.

Approximately five additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.



6.0 Critical Habitat and Uptake Locations

The requirements in this section call for identifying candidate locations of plant and animal life where contaminants are likely to enter exposure pathway webs. This includes habitats of both aquatic and river-dependent terrestrial life. The requirements also call for other critical locations, such as municipal water intakes, to be identified.

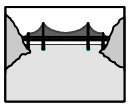
An overview of the requirements in this section is:

(A6.0-1) Candidate habitat locations within the study area shall be identified.

(A6.0-2) Cleanup impact on critical locations shall be assessed. See Section 11.0 of this appendix.

(A6.0-3) The spatial representation scheme shall support realistic representation of exposure to contaminants that occur at critical locations.

(A6.0-4) Any habitats within the study area that are considered high priority or sensitive by the State of Washington shall be accounted for. Habitats critical to the well being of plant and animal species that are classified as threatened, endangered, or sensitive by the State of Washington, the State of Oregon, the Federal Government, and/or the Indian Nations shall be evaluated.



(A6.0-5) Suspect areas with unknown characteristics shall be evaluated.

(A6.0-6) All available sources of information shall be cataloged and included in databases to the extent needed to meet assessment objectives.

Approximately two additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

7.0 Receptors and Exposure Pathways

The requirements in this section call for the identification of candidate receptors from which the receptors of concern (the study set) will be selected (see Appendix II-B). The requirements in this section also call for definition of the pathways through which receptor exposure potentially could occur. Examples of ways receptors may be exposed to contaminants include ingestion, inhalation, dermal exposure, or external radiation exposure.

The requirements in this section suggest some candidate receptors. Additional candidates will be identified upon determination of their criticality to other species because of their essential position in the web of ecosystem relationships.

An overview of the requirements in this section is:

(A7.0-1) An all-inclusive, internally consistent set of receptors shall be identified to include river-dependent humans, plants, animals, and groups whose activities bring them into contact with river corridor resources. These activities include but are not limited to sustenance, recreational, commercial, religious, and cultural practices. The term receptor also includes the culture of affected population groups (for example, the Yakama Indian Nation and Hispanic migrant farm workers) as well as the economic viability of commercial groups (for example, agriculture and river barge transportation). This requirement includes those candidate receptors who come into contact with river resources even though they may be a considerable distance from the river corridor under study. Examples include those coming into contact with commercially marketed fish, wide-ranging animals that drink at the river, water fowl, distributed municipal water, irrigation water, wind-blown sediments, and hydroelectric parts or equipment.

(A7.0-2) All interactions with river resources that may lead to contaminated habitat, food, or receptors and that contribute to exposure levels shall be evaluated.

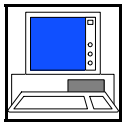
(A7.0-3) All humans, animals, and plants that use habitat in the study area shall be considered as candidate receptors.

(A7.0-4) Pathway webs shall be developed which capture the relationships of the candidate receptors to river resources. Different relationship webs may be needed for each type of potential impact such as health effects, economic effects, and cultural practices. All such webs are expected to embody many of the river ecosystem relationships.

(A7.0-5) Intrusion scenarios which result in potential contaminant transport into the river corridor shall be evaluated for both humans and biota.

(A7.0-6) Exposure mechanisms related to airborne contaminants shall be evaluated for both humans and biota.

Approximately three additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.



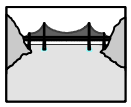
8.0 Dose Assessment

The requirements in this section address the calculation of the dose which results from potential exposure of the receptors to Hanford-derived contaminants.

Dose in individual biota is the presence over time of toxicant concentrations or energy deposition rates in the tissues of a selected receptor. The dose characterization needed varies with receptor role. If a particular biota category is of interest only as a contaminant carrier, simple mass uptake adequately characterizes dose. However, additional properties are needed to define the impact resulting from that dose. Contaminant uptake events that affect economic or socio-cultural groups must be identified.

Doses from past exposures can be obtained by sampling and measuring the receptors. Future doses must be estimated based on exposure models.

Dose calculations shall be made for each of the selected receptors of concern. The receptors of concern comprise a set selected from the candidate receptors (see Section 7.0 of this appendix). The requirements that describe the process to select receptors of concern are in Appendix II-B. After the receptors of concern set is developed, changes will probably seldom be needed. However, dose calculations may be constrained in some fiscal years to only a portion of the receptors of concern by CRCIA resource limitations. If dose calculations cannot be made for all receptors of concern, a subset will be defined using the requirements of dominance (see the Principles and General Requirements and section Appendix II-B).



An overview of the requirements in this section is:

(A8.0-1) Radiation and chemical doses shall be calculated for each of the receptors of concern for all contaminants in the dominant contaminants set.

(A8.0-2) Dose calculation scenarios will be defined for each receptor group having different activities in relationship to river resources and potential exposure. Examples include different scenarios for fishery and related river workers, farm workers where irrigation water is used, Native Americans, Tri-Cities residents, and metropolitan area industrial and office workers. Age and gender shall be considered in establishing absorption or uptake rates.

Approximately six additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

9.0 Receptor Impact and Tolerance Assessment

The requirements in this section translate receptor dose into adverse effects. Both current and future dose and effects from Hanford-derived contaminants must be assessed.

An overview of the requirements in this section is:

(A9.0-1) Acute health effects shall be assessed.

(A9.0-2) Chronic health effects including delayed health effects and cumulative effects from multiple exposures shall be assessed.

(A9.0-3) The full range of genetic effects shall be assessed in all affected populations.

(A9.0-4) The impact to community, tribal, and other populations' quality of life shall be assessed. This includes impact to jobs, housing, produce markets, and recreational opportunities.

(A9.0-5) The impact to tribal quality of life shall be assessed, including but not limited to:

(a) Restrictions on access to ancestral lands and heritage resources

(b) Interruption of transfer of educational and spiritual knowledge within the community and between generations

(c) Protection of cultural and religious values and sacred landscapes

(d) Degree of effort being expended to preserve or restore culturally important sites and resources within the study area

(e) Sustainable economic and environmental practices

(f) Access to open spaces

(g) Visual and aesthetic impact to landscape

(h) Trust in governing institutions

(i) Cost of avoiding exposure and illness

Approximately six additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

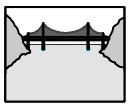
10.0 Assessment Scenarios: Columbia River, Climate, Geological, and Political Changes

Sections 1.0 through 9.0 of this appendix define requirements to comprehensively assess potentially adverse effects of Hanford-derived contaminants in the Columbia River. These requirements are to be applied to:

- Current or normal conditions
- Hypothetical but probable or credible scenarios

The requirements in this section specify the development of candidate scenarios that span all possibilities. Appendix II-B provides the requirements for winnowing these candidates to the most credible study set.

The normal scenario assumed in the preceding sections is defined by parameters that change either very slowly or unpredictably and constitute present-day expectations. While the preceding sections are based on a normal scenario, future scenarios must also be considered. Because all the possible combinations of scenarios would lead to an unworkable number of assessment cases, the number of scenarios must be limited. The set of scenarios to be included in the assessment are those that involve the largest impact of Hanford contaminants to the Columbia River.



An overview of the requirements in this section is:

(A10.0-1) A set of scenarios that depict the maximum impact from Hanford shall be defined.

(A10.0-2) Credible scenarios with parameters that depict increased consequences from Hanford contaminants shall be evaluated to establish a set of scenarios for use in a comprehensive assessment.

(A10.0-3) The limited set of scenarios to be evaluated shall include waste containment performance corresponding to the current Hanford Site disposition baseline for cleanup. See Section 11.0 in this appendix.

(A10.0-4) The limited set of scenarios to be evaluated include potential demographic changes for the river corridor area under study.

(A10.0-5) Scenarios to be assessed shall include but are not limited to:

(a) Scenarios that depict the groundwater recharge rate in a way that the maximum impact from Hanford is assessed. Examples are climate change, future site uses including irrigated agriculture, and river channel changes.

(b) Scenarios that depict contaminant dilution by groundwater or Columbia River water in a way that the maximum impact from Hanford is assessed. Examples are flood and drought scenarios, upgradient injection or extraction, disposition of present or new dams, and geologic events.

(c) Scenarios that depict enhanced remobilization of sediment in a way that the maximum impact from Hanford is assessed. Examples are future dredging, disposition of present or new dams, and river channel changes.

(d) Scenarios that depict potential changes in receptors. Examples are future Hanford land use scenarios, Hanford Site accident scenarios, transportation accident scenarios, demographic scenarios, economic scenarios, institutional evolution scenarios, and cultural evolution scenarios.

(A10.0-6) Scenarios to be evaluated include but are not limited to:

(a) Scenarios that involve increased inventories of dangerous materials at Hanford. An example is a projected future plutonium repository.

(b) Scenarios that depict the impact of newly introduced foreign species. An example is the introduction of Northern Pike.

(c) Scenarios that depict loss of institutional control over the Hanford Site after various time periods. The full range of probable times for loss of institutional control shall be evaluated.

(d) Scenarios that depict loss of cleanup funding

(e) Scenarios that depict the future production of plutonium and other new missions for the Hanford Site

(f) Scenarios that depict ecosystem changes

Approximately two additional pages of explicit, detailed requirements for this section have been identified from stakeholder concerns, issues, and experience. They do not appear in this draft due to insufficient time to develop an orderly presentation reasonably free of error or redundancy. They should be separately available by this draft's publication date for those who would like to request a copy. They will be included in the final document.

11.0 Hanford Site Disposition Baseline

The requirements in this section call for the Columbia River impact assessment to be consistent with the current definition of the Hanford Site after all cleanup and waste disposal actions are complete and institutional controls cease. Because this may be a very long period of time, an assessment is also needed for the transition period when operations are in process.

As the strategic planning changes which defines the Hanford Site post-operations end state, the assessment must be updated.

An overview of the requirements in this section is:

(A11.0-1) A complete disposition baseline shall be documented for purposes of the assessment.

(A11.0-2) The assessment shall be consistent with the current revisions of the Hanford disposition baseline.

(A11.0-3) The impact from actual and proposed remedial actions shall be assessed for compatibility with target, end-state conditions.

(A11.0-4) The retrieveability of new waste forms that are part of either interim or permanent remedies and which affect the Columbia River shall be assessed.